## 3.3 *PLANNING FACTORS/TRANSMISSION ROBUSTNESS*

The Advisory Committee considers transmission performance under three selection criteria: Service Area, Accommodation Percentage, and Transmission Robustness.

Service Area and Accommodation Percentage are calculated using planning factors derived, in large part, from the data summarized here. When ATV is the desired signal, a planning factor is the desired-to-undesired (i.e., D/U) ratio for judgements of "perceptible, but not annoying" (i.e., Impairment Grade 4.0). If no subjective test is done, however, the D/U ratio for the TOV is used instead. When NTSC is the desired signal, a planning factor is the D/U ratio for judgements of "slightly annoying" (i.e., Impairment Grade 3.0). Service Area and Accommodation Percentage are calculated using many planning factors (e.g., those from noise, co-channel interferences, adjacent-channel interferences, etc.). Accordingly, the relative performance of a system overall may not readily be predicted from its relative performance on any single planning factor.

Transmission Robustness considers the ability of the system to withstand impairment from any of a number of known sources, many of which are considered here.

In Impairment/Interference tests in which the ATV system was the desired signal, the all-digital systems typically exhibited "cliff-like" failure characteristics.[2] Further to the provisions of Document SSWP2-0390 (Section 1.6.5, paragraph 5) and the advice of PS/WP-3 that impairment ranges of less than 5 dB not be explored with non-expert viewers, subjective tests typically were not done in these cases.

The results of assessments of Random Noise into ATV are summarized in TABLE 2.

For Random Noise into ATV, TABLE 2 shows that only Narrow-MUSE and AD-HDTV were brought to subjective test. Of the two systems, AD-HDTV performed better. The reader is encouraged to examine FIGURE 2, which illustrates the failure characteristics of the two systems and the TOVs and POUs for all systems.

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[2] This may be defined as degeneration from a state of barely visible transmission impairment (i.e., the TOV) to a state in which the video is judged by experts as unusable (i.e., the POU) in fewer than 5 dB. Note: the POU does not imply absence of the video or loss of the signal.

## TABLE 2

## RANDOM NOISE INTO ATV

G4: D/U ratio for mean grade of "perceptible, but not annoying" (negative values are better); [ ]: further to SSWP2-0390, no subjective test was done and the D/U at TOV is given in brackets; *R*: statistical ranking of systems (lower values are better); *[.]*: no subjective test was done and, thus, no rank could be determined

| | RANDOM NOISE (into ATV) | |
|---|---|---|
| **N-MUSE** | G4:<br>*R:* | +37.93<br>*2.0* |
| **DigiCipher** | G4:<br>*R:* | [+15.95]<br>*[ . ]* |
| **DSC-HDTV** | G4:<br>*R:* | [+15.97]<br>*[ . ]* |
| **AD-HDTV** | G4:<br>*R:* | +18.19[1]<br>*1.0* |
| **CCDC** | G4:<br>*R:* | [+15.38]<br>*[ . ]* |

**NOTES:**

1. For tests of Random Noise into AD-HDTV, the range between the TOV and the POU was less than 5 dB and subjective tests with non-experts normally would not have been done. However, at the request of the Chairman of SS/WP-2, a subjective test with non-experts was done in this case. The D/U at TOV was +18.41 dB.
2. Desired signal levels were -28 dBm for Narrow-MUSE and -38 dBm for the remaining systems.

The results of assessments of Co-Channel, Lower-Adjacent Channel, and Upper-Adjacent Channel Interference from ATV to ATV are summarized in TABLE 3.

For Co-Channel Interference from ATV to ATV, TABLE 3 shows that only Narrow-MUSE was brought to subjective test. The reader is encouraged to examine FIGURE 3, which illustrates the failure characteristic of the Narrow-MUSE system and the TOVs and POUs for all systems.

For Lower-Adjacent Channel Interference from ATV to ATV, TABLE 3 shows that only Narrow-MUSE was brought to subjective test. The reader is encouraged to examine FIGURE 4, which illustrates the failure characteristic of the Narrow-MUSE system and the TOVs and POUs for all systems.

For Upper-Adjacent Channel Interference from ATV to ATV, TABLE 3 shows that only Narrow-MUSE was brought to subjective test. The reader is encouraged to examine FIGURE 5, which illustrates the failure characteristic of the Narrow-MUSE system and the TOVs and POUs for all systems.

## TABLE 3

## INTERFERENCE FROM ATV TO ATV

G4: D/U ratio for mean grade of "perceptible, but not annoying" (negative values are better); [ ]: further to SSWP2-0390, no subjective test was done and the D/U at TOV is given in brackets; *R*: statistical ranking of systems (lower values are better); *[.]*: no subjective test was done and, thus, no rank could be determined

| | CO-CHANNEL (ATV-to-ATV) | LOWER-ADJ. (ATV-to-ATV) | UPPER-ADJ. (ATV-to-ATV) |
|---|---|---|---|
| N-MUSE | G4: +31.21<br>*R:* | G4: -15.48<br>*R:* | G4: +16.55<br>*R:* |
| DigiCipher | G4: [+16.37]<br>*R:* *[ . ]* | G4: [-23.20]<br>*R:* *[ . ]* | G4: [-23.04]<br>*R:* *[ . ]* |
| DSC-HDTV | G4: [+18.24]<br>*R:* *[ . ]* | G4: [-35.21]<br>*R:* *[ . ]* | G4: [-36.02]<br>*R:* *[ . ]* |
| AD-HDTV | G4: [+19.09]<br>*R:* *[ . ]* | G4: [-33.33]<br>*R:* *[ . ]* | G4: [-16.76]<br>*R:* *[ . ]* |
| CCDC | G4: [+16.59]<br>*R:* *[ . ]* | G4: [-31.55]<br>*R:* *[ . ]* | G4: [-32.38]<br>*R:* *[ . ]* |

NOTES:
1. No rank is provided for Narrow-MUSE as no other system was brought to subjective tests by non-experts.
2. Desired signal levels were -58 dBm for Narrow-MUSE and -68 dBm for the remaining systems.

## TABLE 4

## INTERFERENCE FROM NTSC TO ATV

G4: D/U ratio for mean grade of "perceptible, but not annoying" (negative values are better); [ ]: further to SSWP2-0390, no subjective test was done and the D/U at TOV is given in brackets; *R*: statistical ranking of systems (lower values are better); *[.]*: no subjective test was done and, thus, no rank could be determined

| | CO-CHANNEL (NTSC-to-ATV) | | LOWER-ADJ. (NTSC-to-ATV) | | UPPER-ADJ. (NTSC-to-ATV) | |
|---|---|---|---|---|---|---|
| **N-MUSE** | G4:<br>*R:* | +20.72<br>*3.0* | G4:<br>*R:* | +27.59 | G4:<br>*R:* | -11.76 |
| **DigiCipher** | G4:<br>*R:* | [+ 7.61]<br>*[ . ]* | G4:<br>*R:* | [-30.36]<br>*[ . ]* | G4:<br>*R:* | [-23.75]<br>*[ . ]* |
| **DSC-HDTV** | G4:<br>*R:* | + 4.65[3,4]<br>*2.0* | G4:<br>*R:* | [-43.17]<br>*[ . ]* | G4:<br>*R:* | [-42.12]<br>*[ . ]* |
| **AD-HDTV** | G4:<br>*R:* | + 0.11[2]<br>*1.0* | G4:<br>*R:* | [-37.85]<br>*[ . ]* | G4:<br>*R:* | [-36.45]<br>*[ . ]* |
| **CCDC** | G4:<br>*R:* | [+ 8.05]<br>*[ . ]* | G4:<br>*R:* | [-37.66]<br>*[ . ]* | G4:<br>*R:* | [-37.16]<br>*[ . ]* |

**NOTES:**

1. No rank is provided for Narrow-MUSE for Lower-Adjacent Channel Interference or for Upper-Adjacent Channel Interference as no other system was brought to subjective tests by non-experts.
2. For Co-Channel Interference into AD-HDTV, the range between the TOV and the POU was less than 5 dB and subjective tests with non-experts normally would not have been done. However, at the request of the Chairman of SS/WP-2, subjective tests were done in this case. The D/U at TOV was +0.50 dB.
3. For sequences, the quality of DSC-HDTV decreased as the interfering signal increased; for the still, however, there was no loss in quality over the range examined in the test. The results given here are those for sequences.
4. At TOV for DSC-HDTV, the sequences showed more severe impairments than were seen in other recordings of DSC-HDTV at TOV. As G4 is influenced by performance at TOV, it should be interpreted with caution. The D/U at TOV was +3.47 dB.
5. Desired signal levels were -58 dBm for Narrow-MUSE and -68 dBm for the remaining systems.

The results of assessments of Co-Channel, Lower-Adjacent Channel, and Upper-Adjacent Channel Interference from ATV to NTSC are summarized in TABLE 5.

For Co-Channel Interference from ATV to NTSC, TABLE 5 shows that all five systems were brought to subjective test. Of the five systems, Narrow-MUSE performed better than the other four systems. The reader is encouraged to examine FIGURE 9, which illustrates the failure characteristics of NTSC in response to interference from the five systems and the

For Upper-Adjacent Channel Interference from ATV to NTSC, TABLE 5 shows that all five systems were brought to subjective test. Of the five systems, DigiCipher performed best; CCDC performed next best, followed in order by Narrow-MUSE, DSC-HDTV, and AD-HDTV. The reader is encouraged to examine FIGURE 11, which illustrates the failure characteristics of NTSC in response to interference from the five systems and the NTSC TOVs and POUs in response to all systems.

**TABLE 5**

**INTERFERENCE FROM ATV TO NTSC**

(3; D/U ratio for mean grade of "slightly annoying" (negative values are better); R: statistical ranking of systems

## TABLE 7

## CABLE THIRD-ORDER INTERMODULATION DISTORTION

G4: undesired level (relative to carrier) for mean grade of "perceptible, but not annoying" (positive values are better); [ ]: further to SSWP2-0390, no subjective test was done and the undesired level (relative to carrier) at TOV is given in brackets; *R*: statistical ranking of systems (lower values are better); *[.]*: no subjective test was done and, thus, no rank could be determined

| | 3rd-ORDER I'MOD (to ATV) | |
|---|---|---|
| **N-MUSE** | G4:<br>*R:* | -22.70 |
| **DigiCipher** | G4:<br>*R:* | [-31.00]<br>*[ . ]* |
| **DSC-HDTV** | G4:<br>*R:* | [-11.00]<br>*[ . ]* |
| **AD-HDTV** | G4:<br>*R:* | [-16.00]<br>*[ . ]* |
| **CCDC** | G4:<br>*R:* | [-33.00]<br>*[ . ]* |

NOTES:
1. No rank is provided for Narrow-MUSE as no other system was brought to subjective tests by non-experts.
2. Desired signal levels were -43 dBm for Narrow-MUSE and -53 dBm for the remaining systems.

## 3.5 *CONCLUDING COMMENTS*

Subject to such comments as are made in the text and TABLES of this report, the data appear to provide a sound basis for decision making. The interpretation of some of the data, however, may need to be tempered judiciously by consideration of whether deficiencies in performance reflect deficiencies in test materials, implementation, or system.

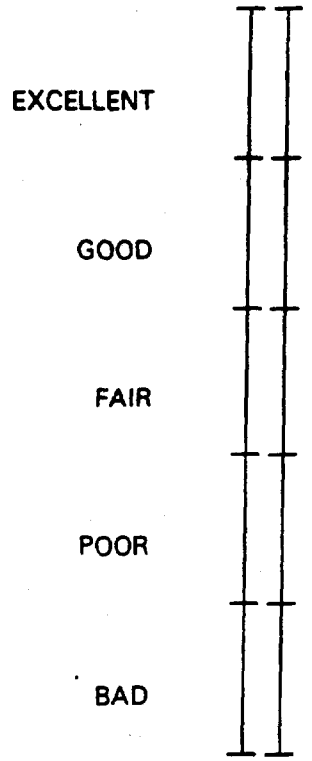



**ILLUSTRATION 1.** **SAMPLE OF JUDGEMENT SCALES USED IN QUALITY TESTS.**

IMPERCEPTIBLE ☐

PERCEPTIBLE, BUT NOT ANNOYING ☐

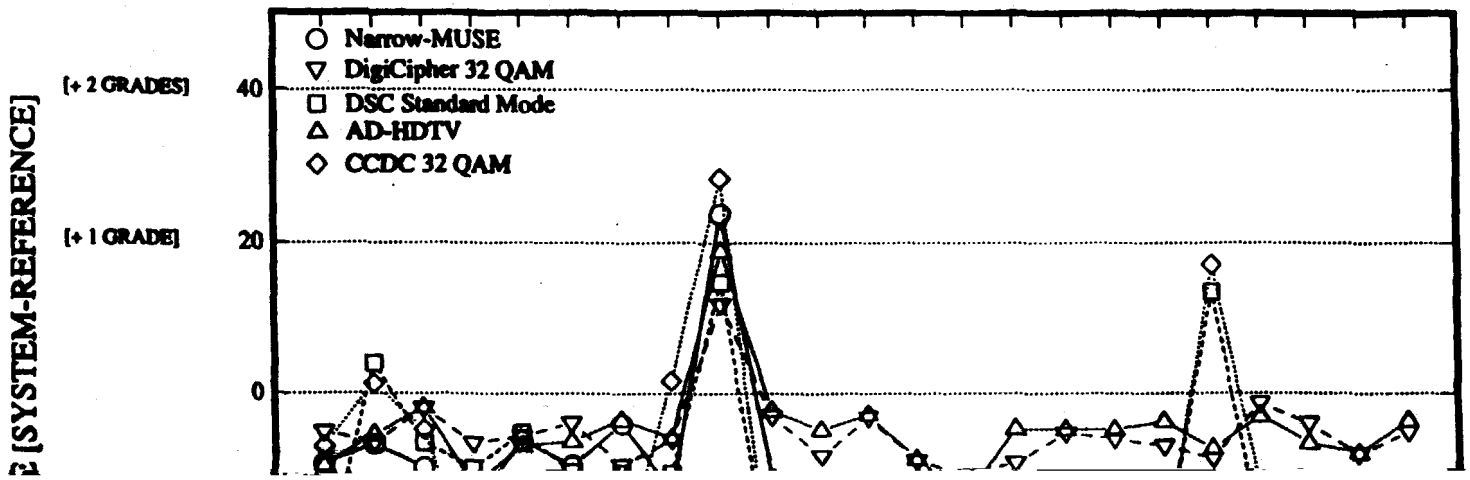
SLIGHTLY ANNOYING ☐

ANNOYING ☐

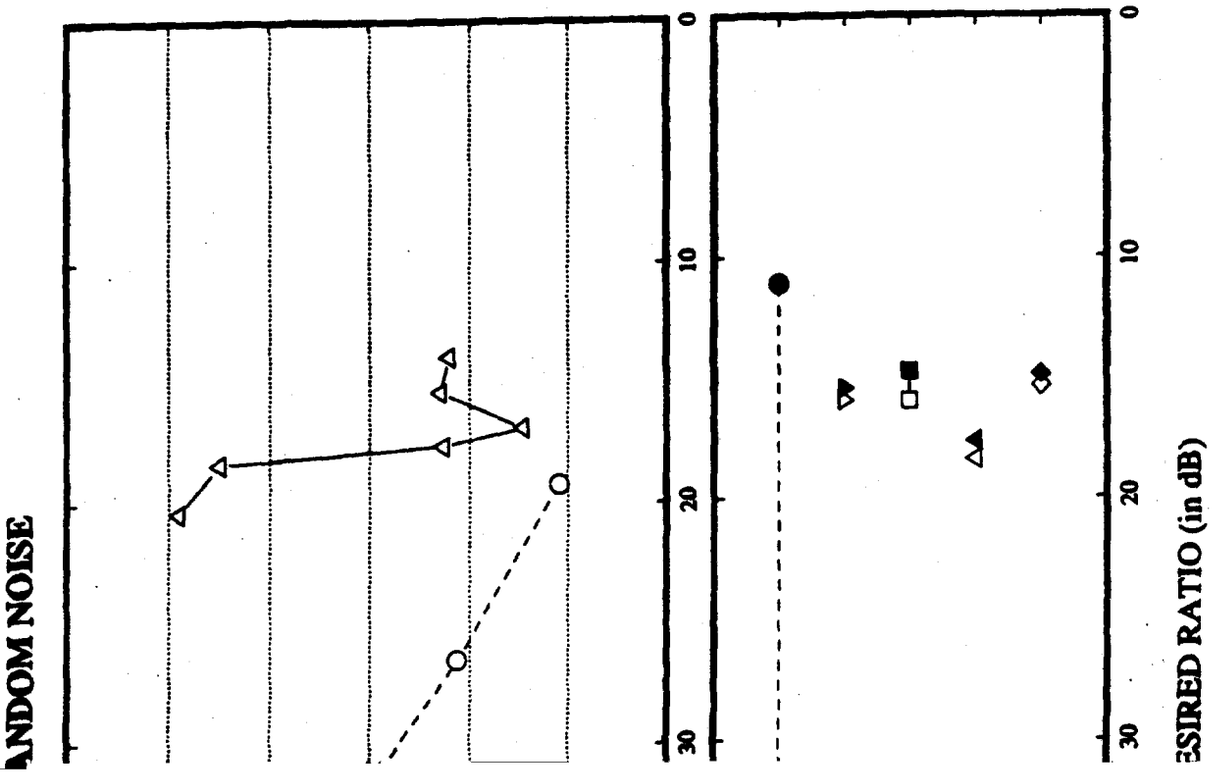
VERY ANNOYING ☐

**ILLUSTRATION 2.** **SAMPLE OF IMPAIRMENT SCALE USED IN IMPAIRMENT AND INTERFERENCE TESTS.**

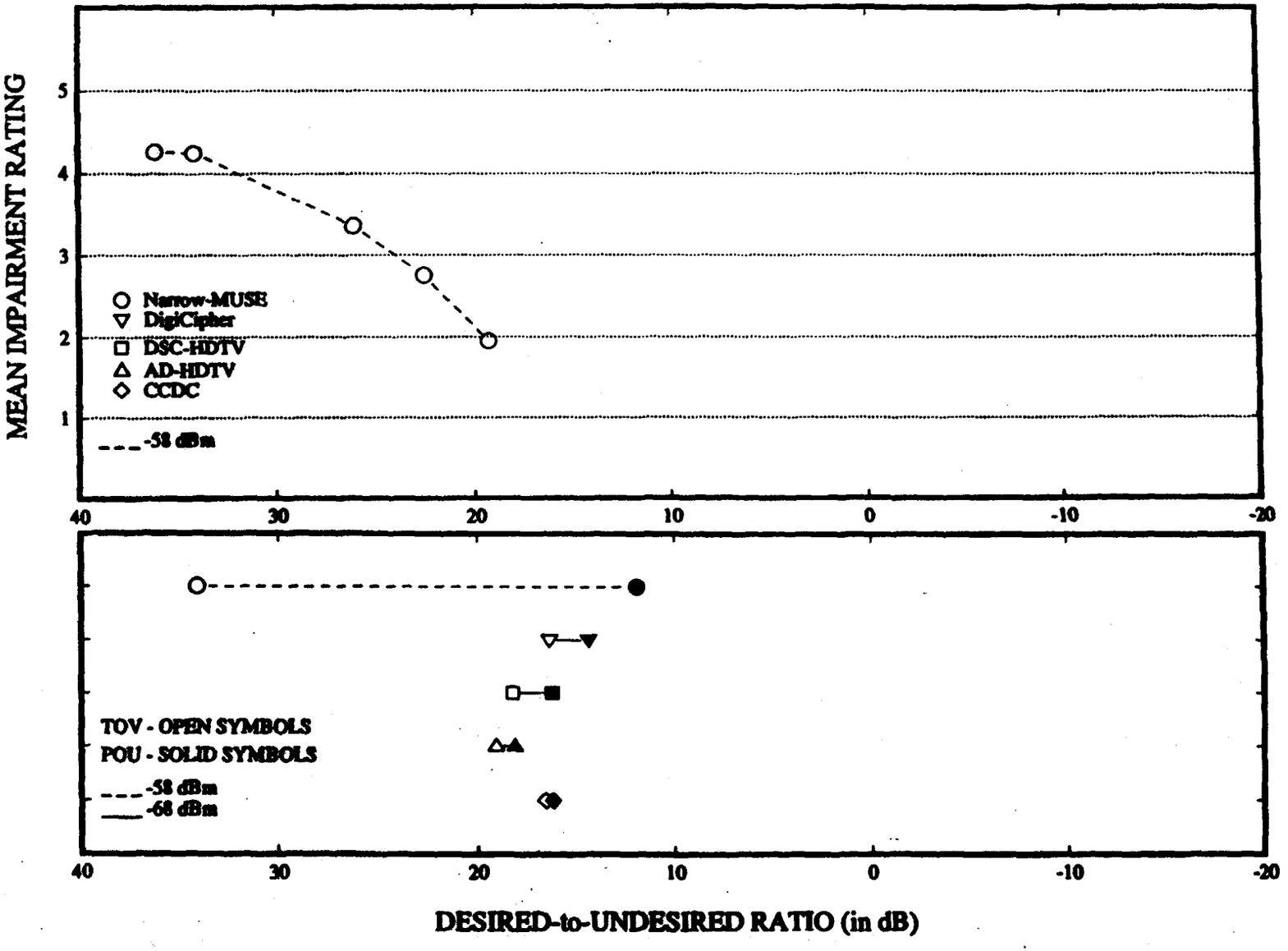
## FIGURE 1: ATV BASIC RECEIVED QUALITY DIFFERENCE SCORES




ATEL COMPAR


ANDOM NOISE
0
10
20
30
0
10
20
30
ESIRED RATIO (in dB)

## FIGURE 3: CO-CHANNEL INTERFERENCE (ATV-to-ATV)



## FIGURE 4: LOWER-ADJACENT CHANNEL INTERFERENCE (ATV-to-ATV)

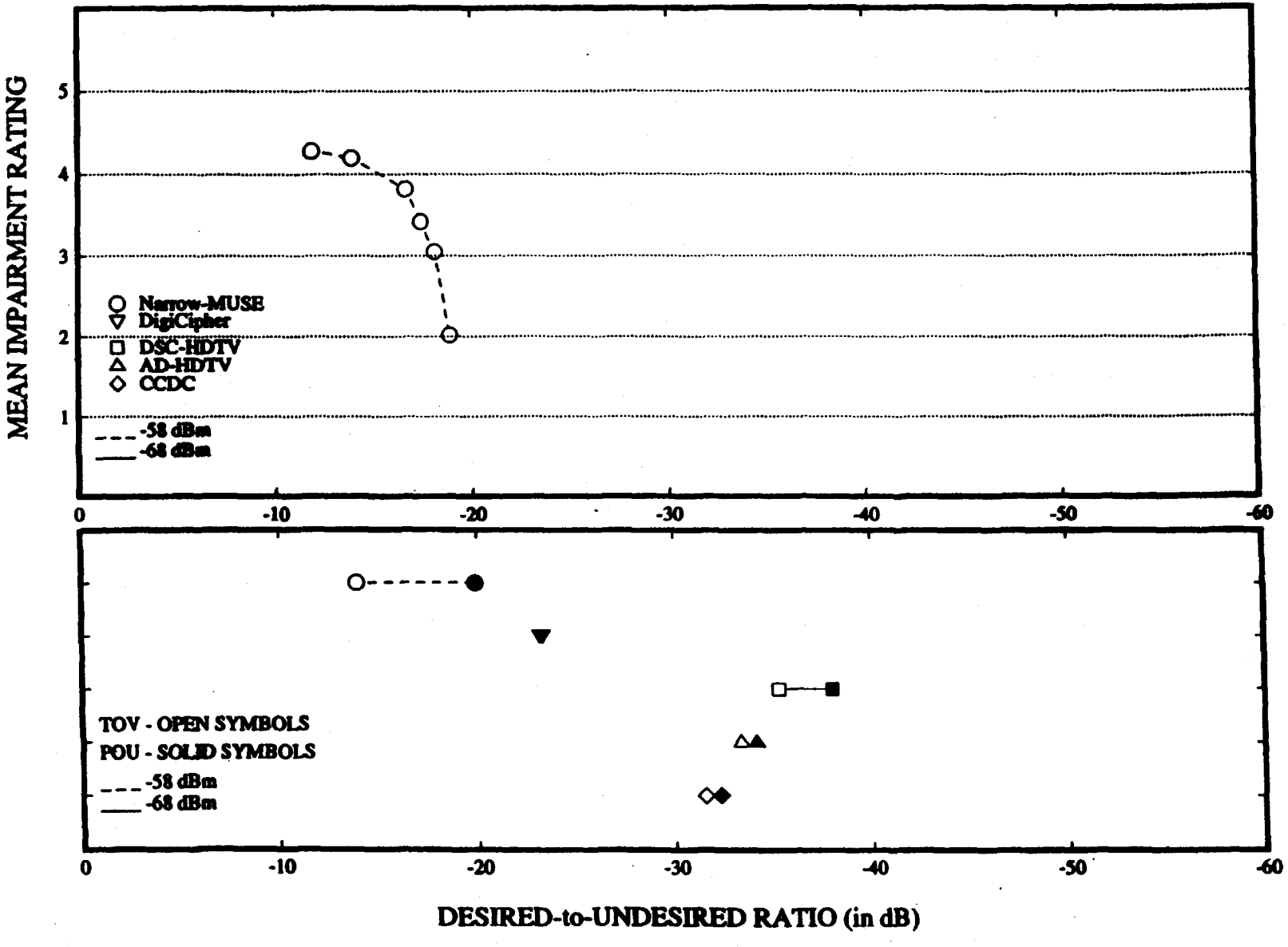
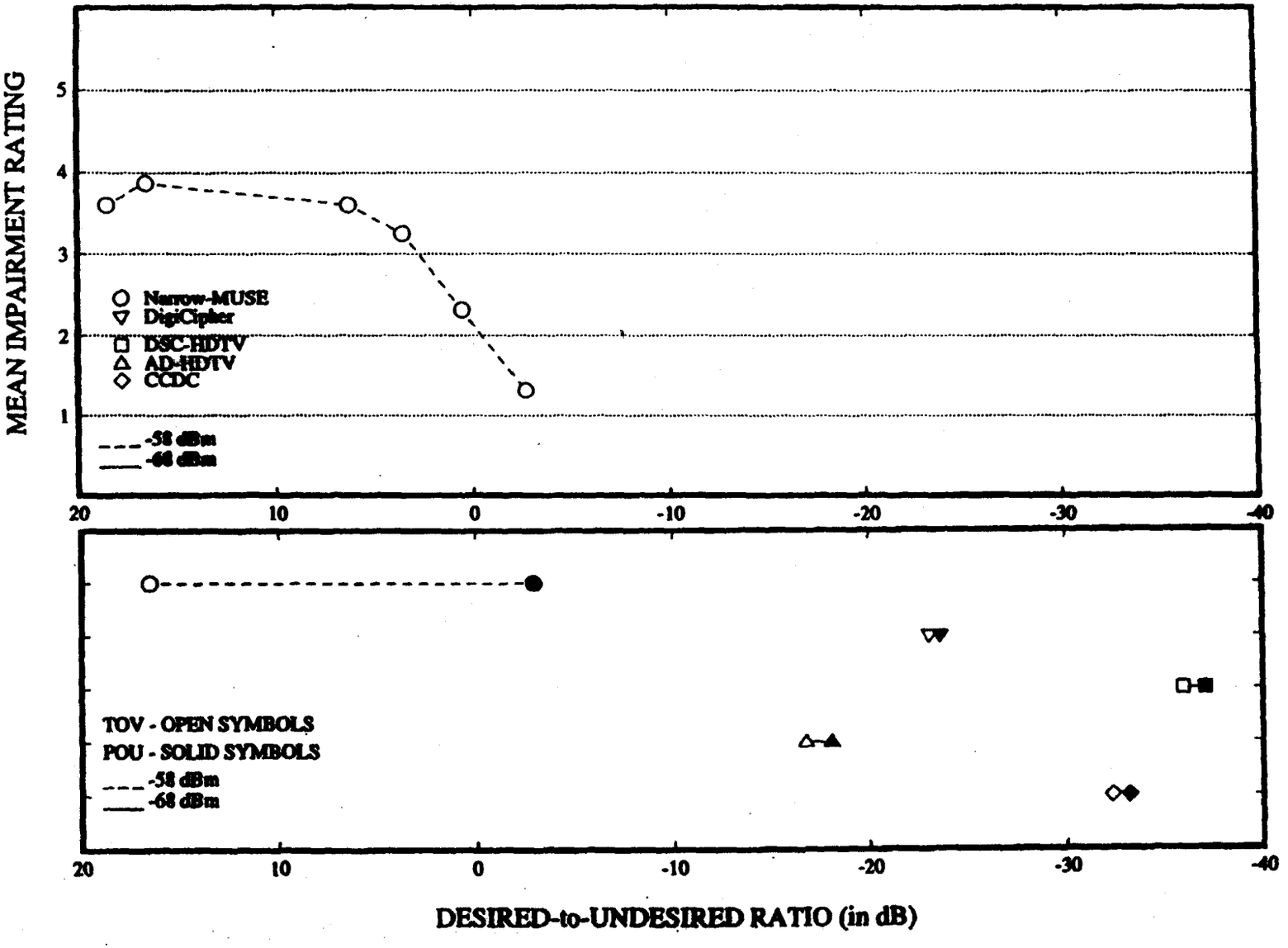


**FIGURE 5: UPPER-ADJACENT CHANNEL INTERFERENCE (ATV-to-ATV)**



## FIGURE 6: CO-CHANNEL INTERFERENCE (NTSC-to-ATV)

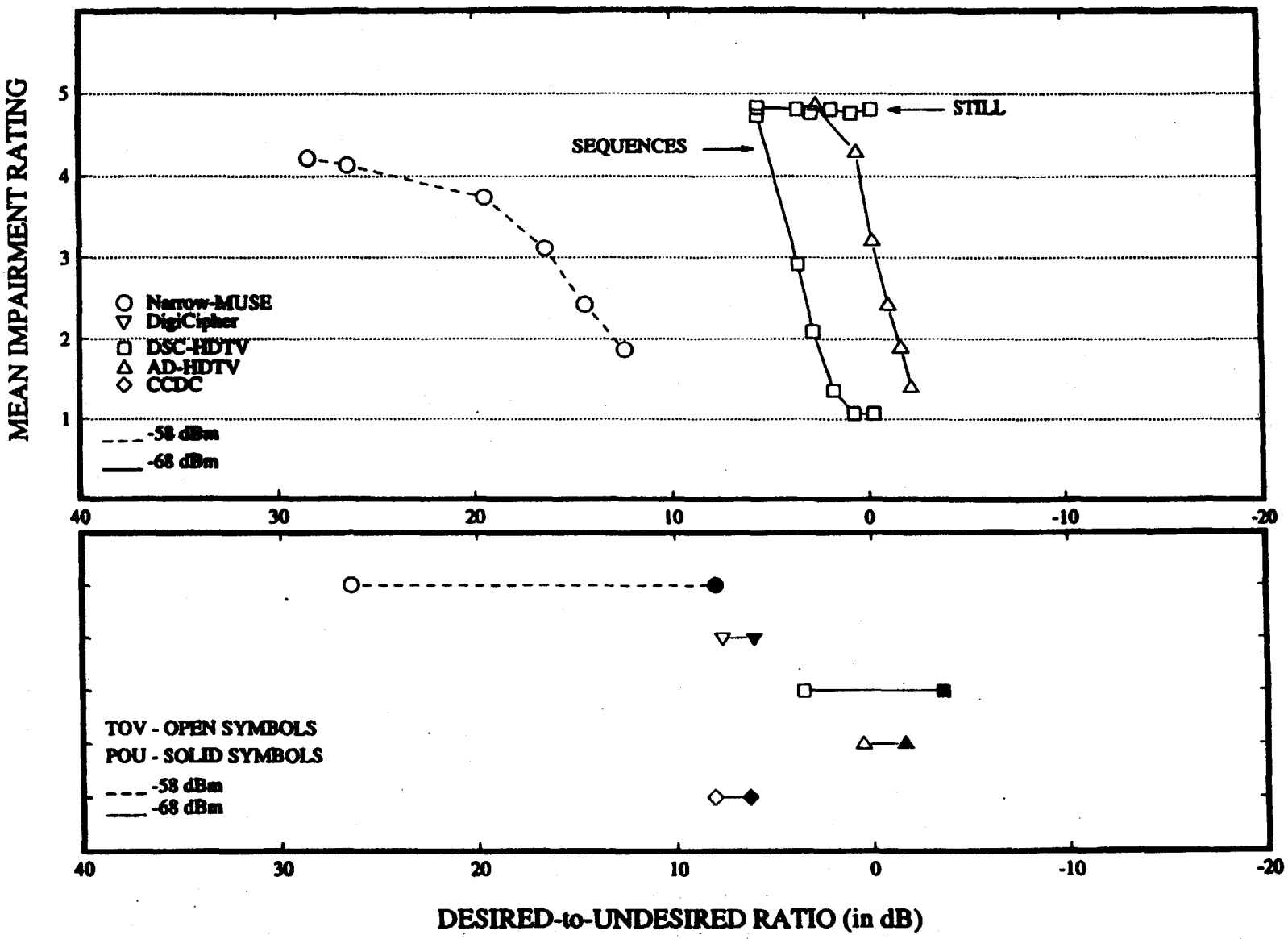


**FIGURE 7: LOWER-ADJACENT CHANNEL INTERFERENCE (NTSC-to-ATV)**

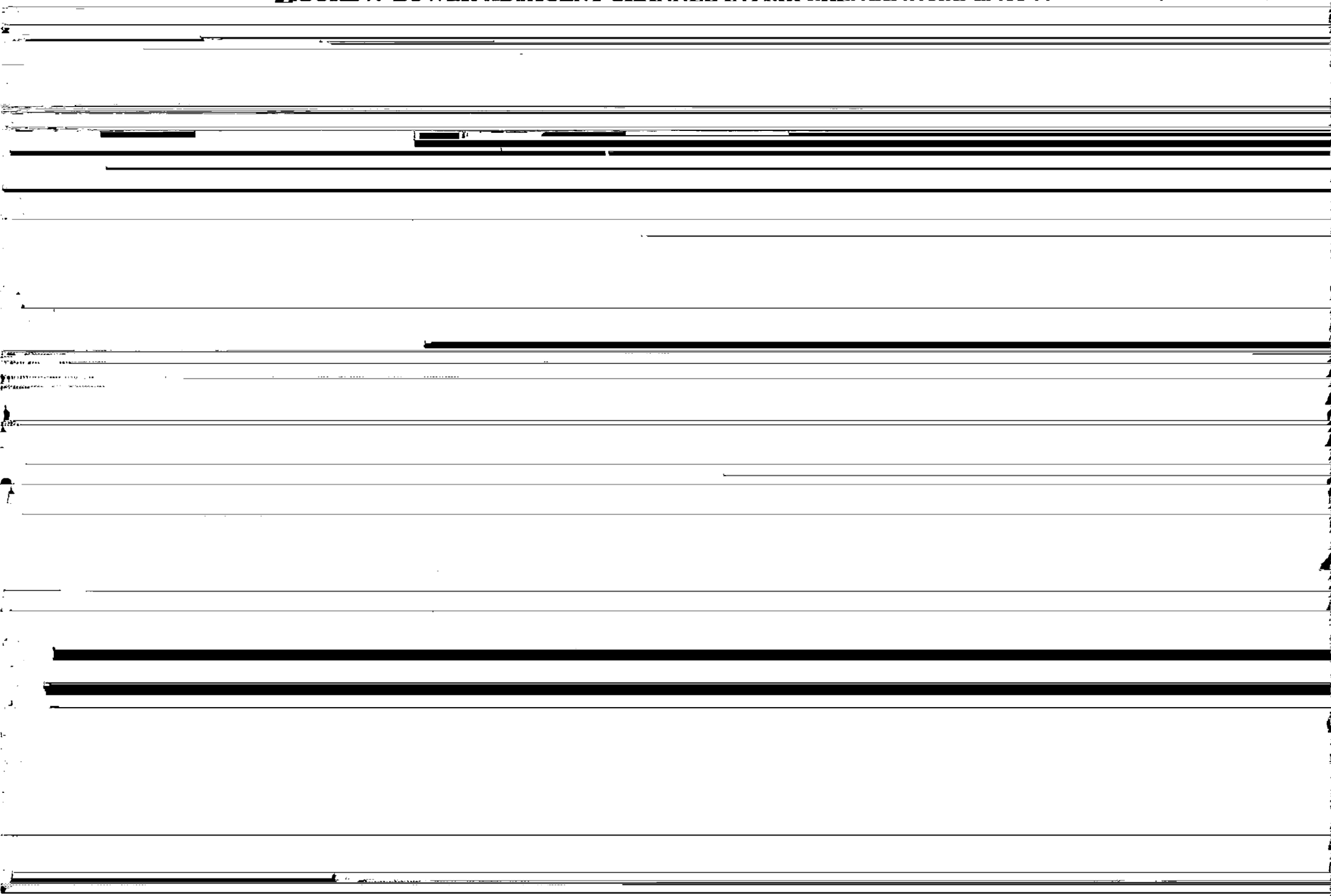


**FIGURE 8: UPPER-ADJACENT CHANNEL INTERFERENCE (NTSC-to-ATV)**

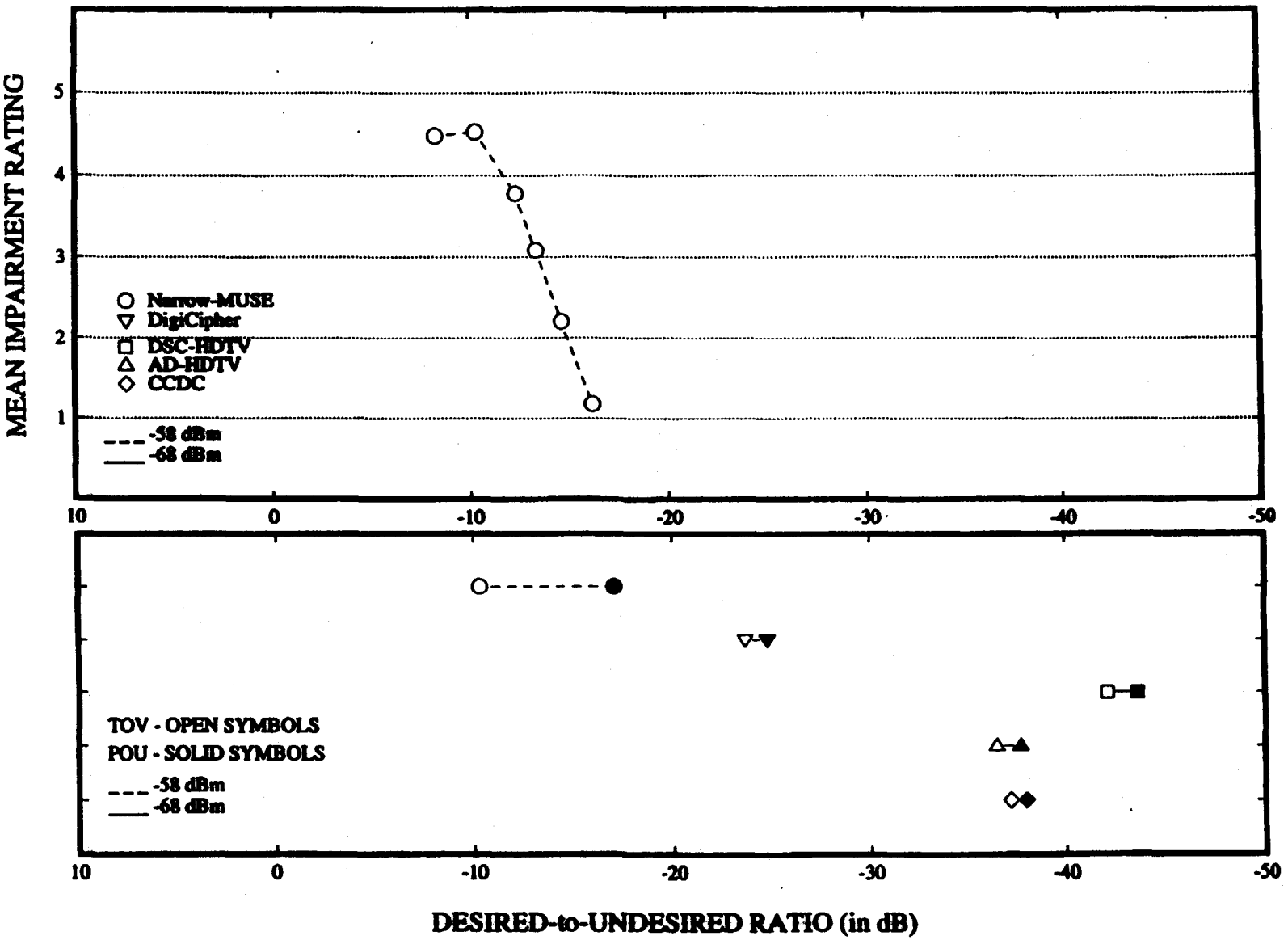


**FIGURE 9: CO-CHANNEL INTERFERENCE (ATV-to-NTSC)**

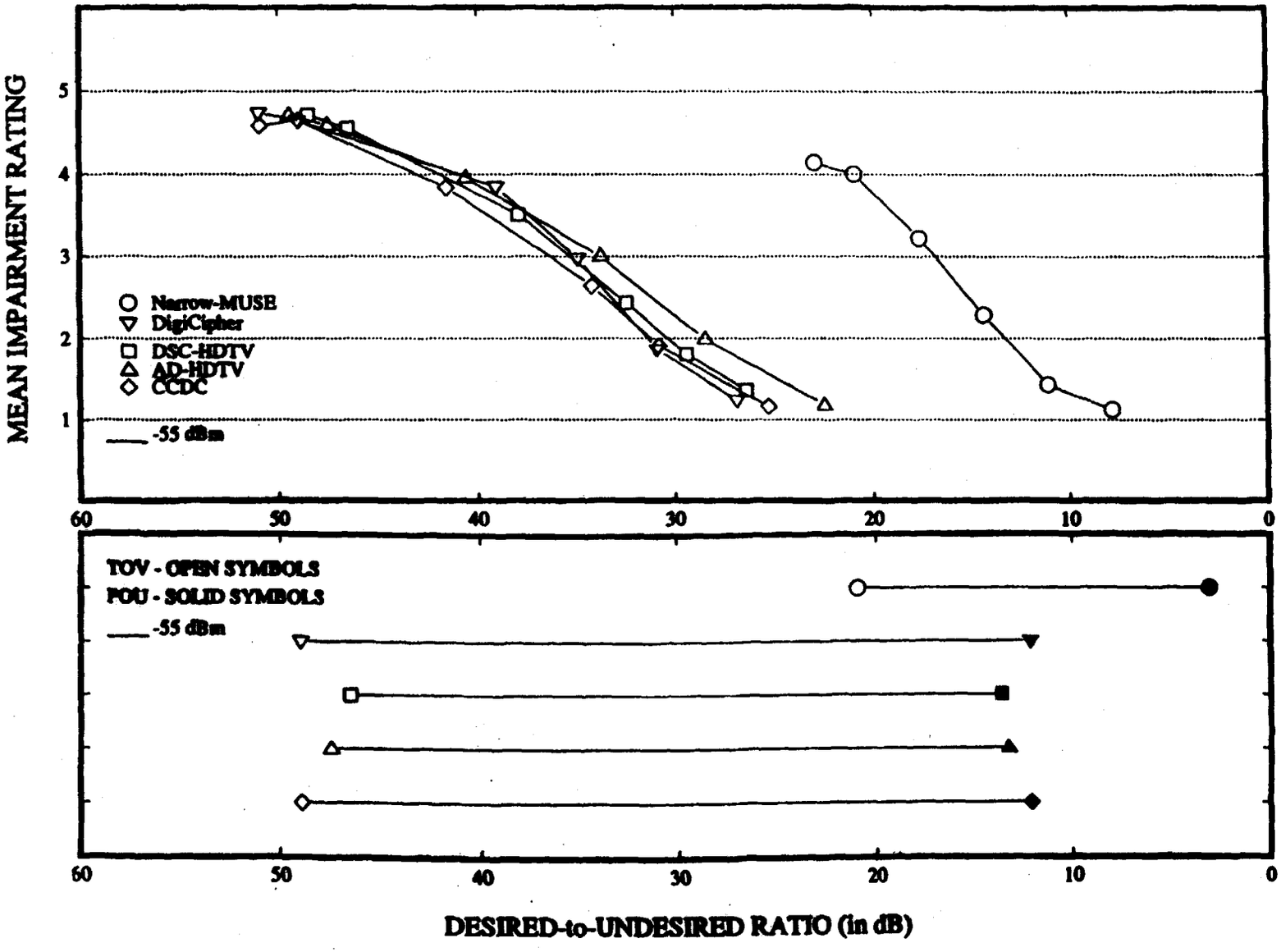
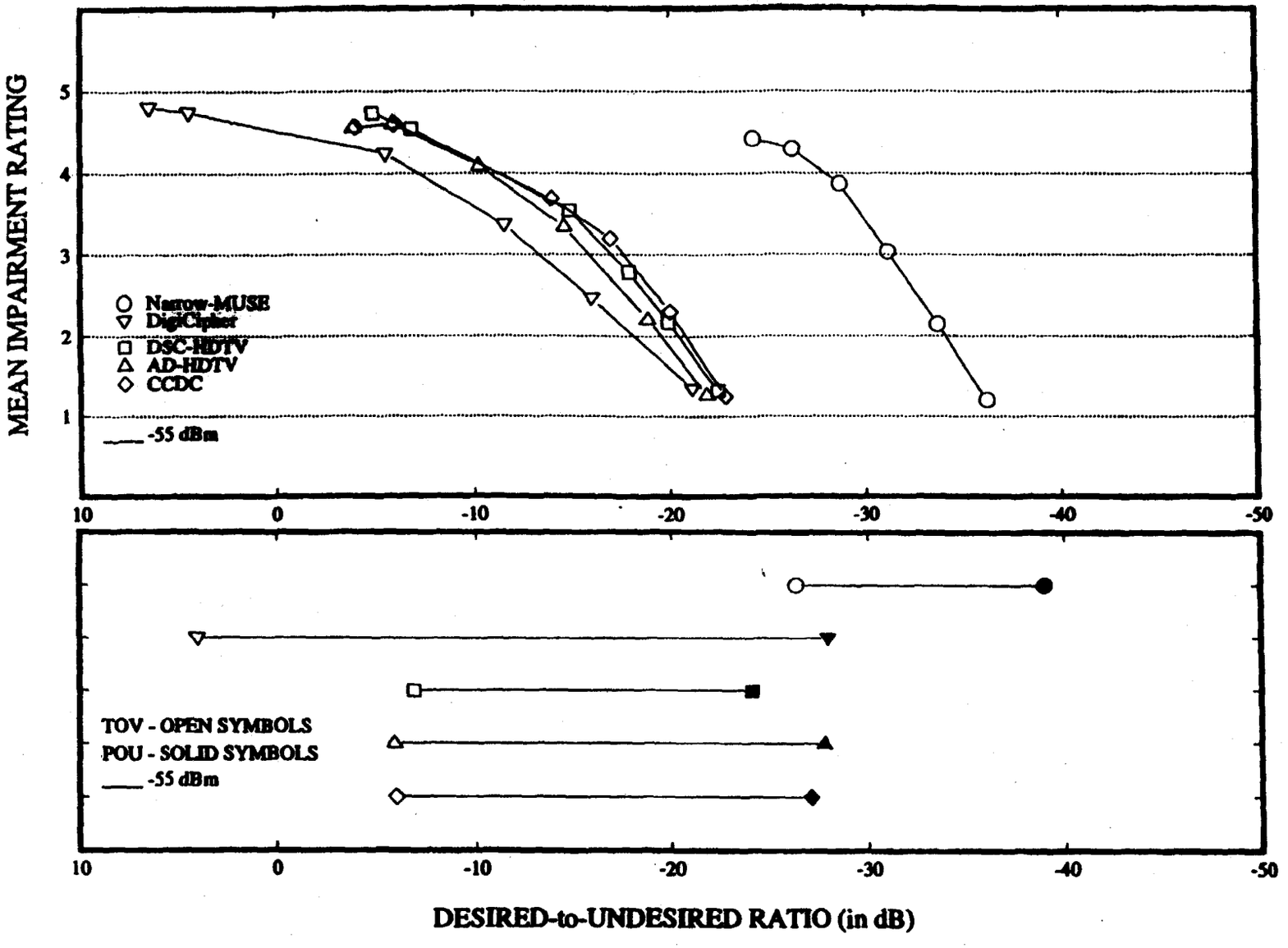


**FIGURE 10: LOWER-ADJACENT CHANNEL INTERFERENCE (ATV-to-NTSC)**



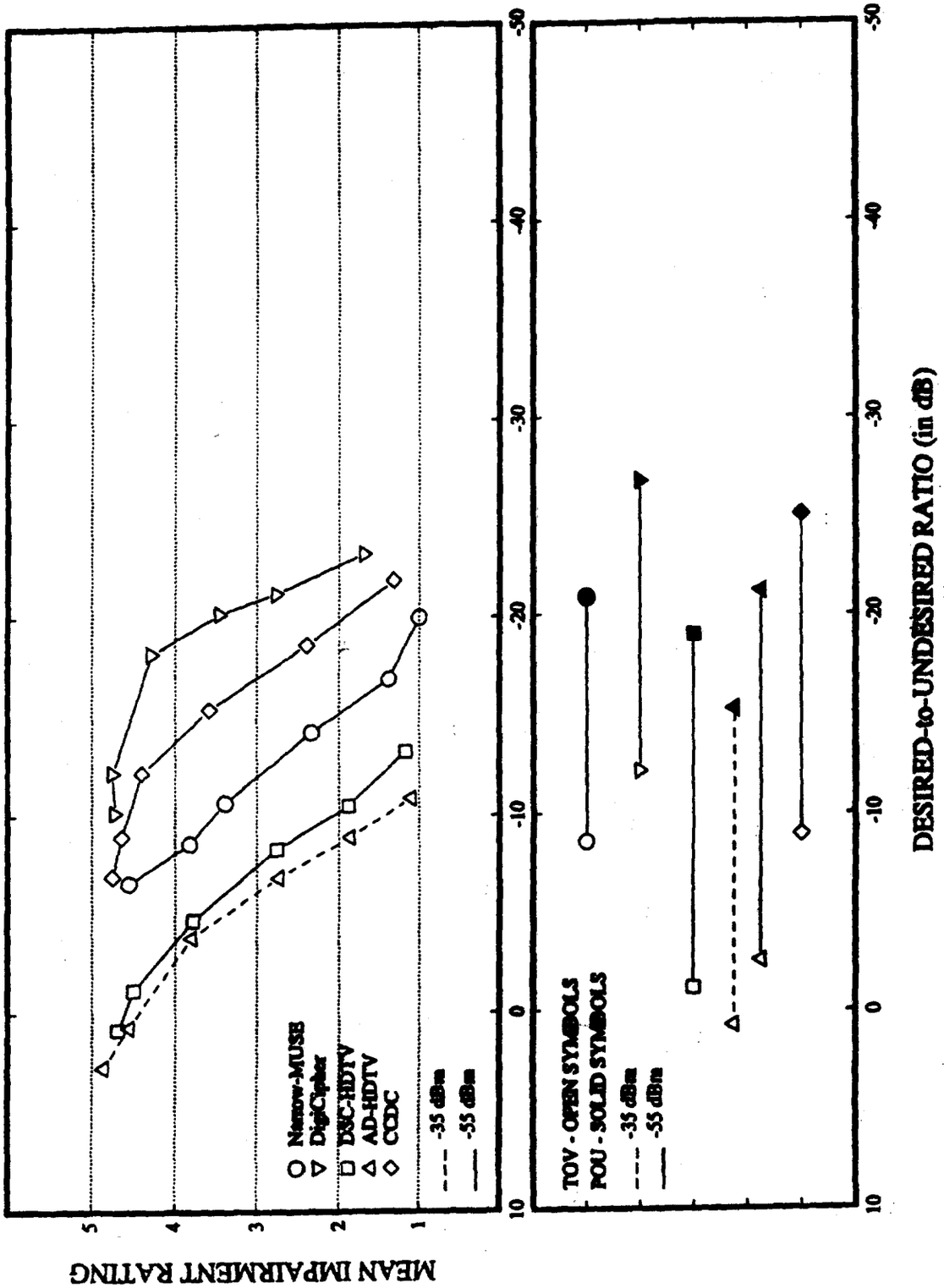
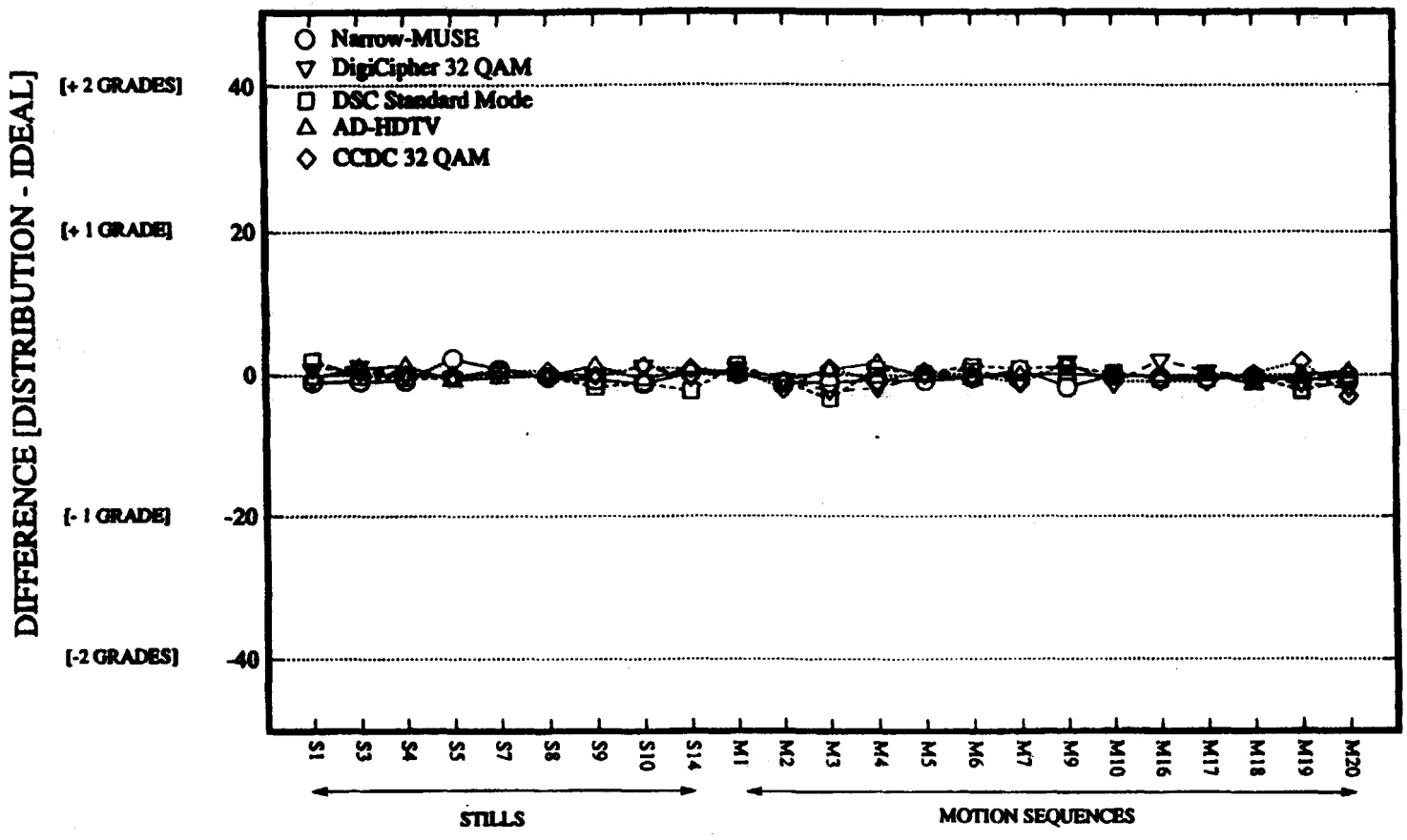


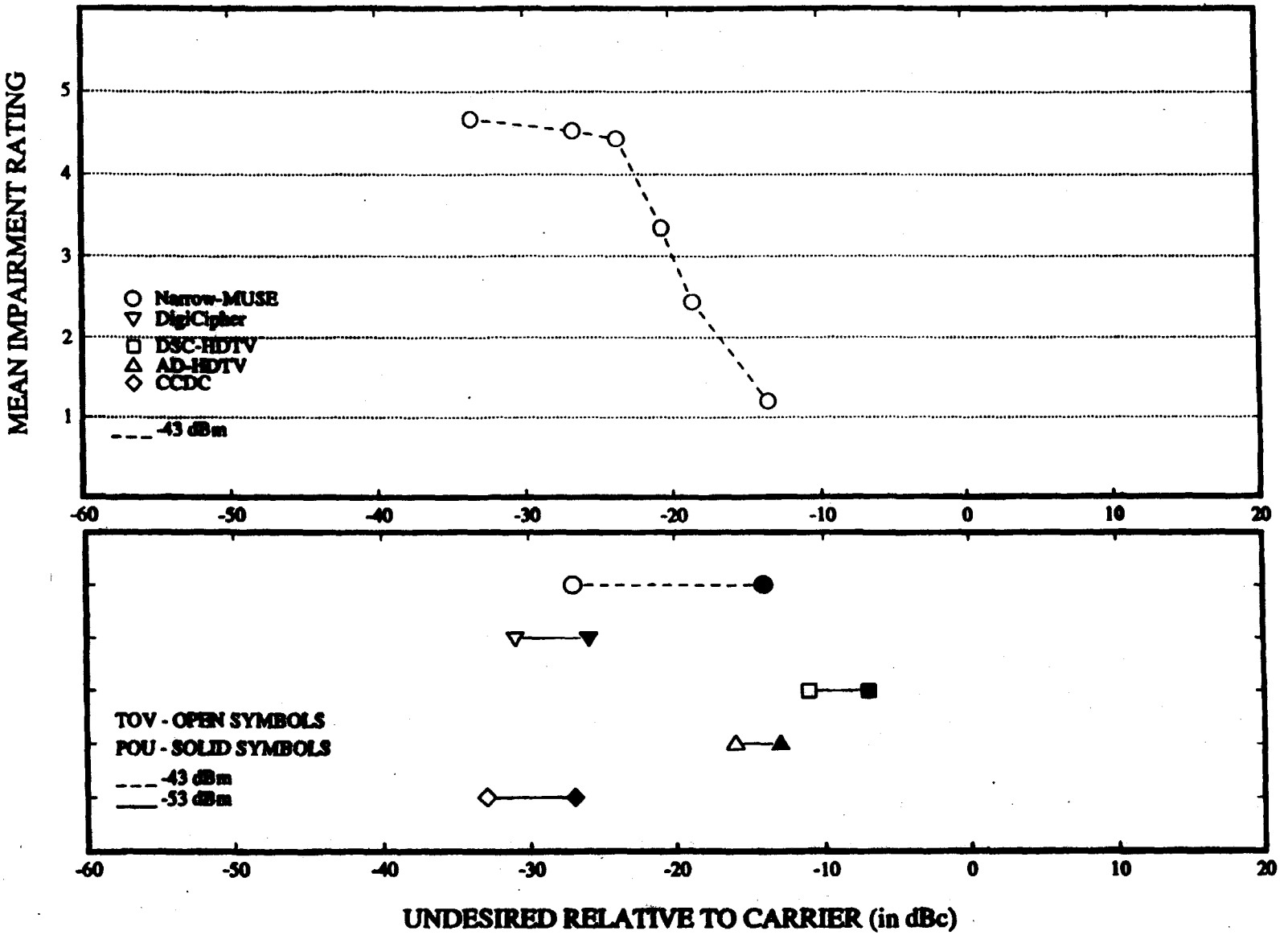

FIGURE 11: UPPER-ADJACENT CHANNEL INTERFERENCE (ATV-to-NTSC)

## FIGURE 12: ATV CABLE RECEIVED QUALITY DIFFERENCE SCORES




[S1-S10 SCANNED FROM STILLS; M1-M10 TAKEN FROM CAMERA ; M17-M20 TRANSFERRED FROM FILM VIA CAMERA; S14, M16 CONVERTED FROM GRAPHIC SOURCES]

## FIGURE 13: CABLE THIRD-ORDER INTERMODULATION DISTORTION



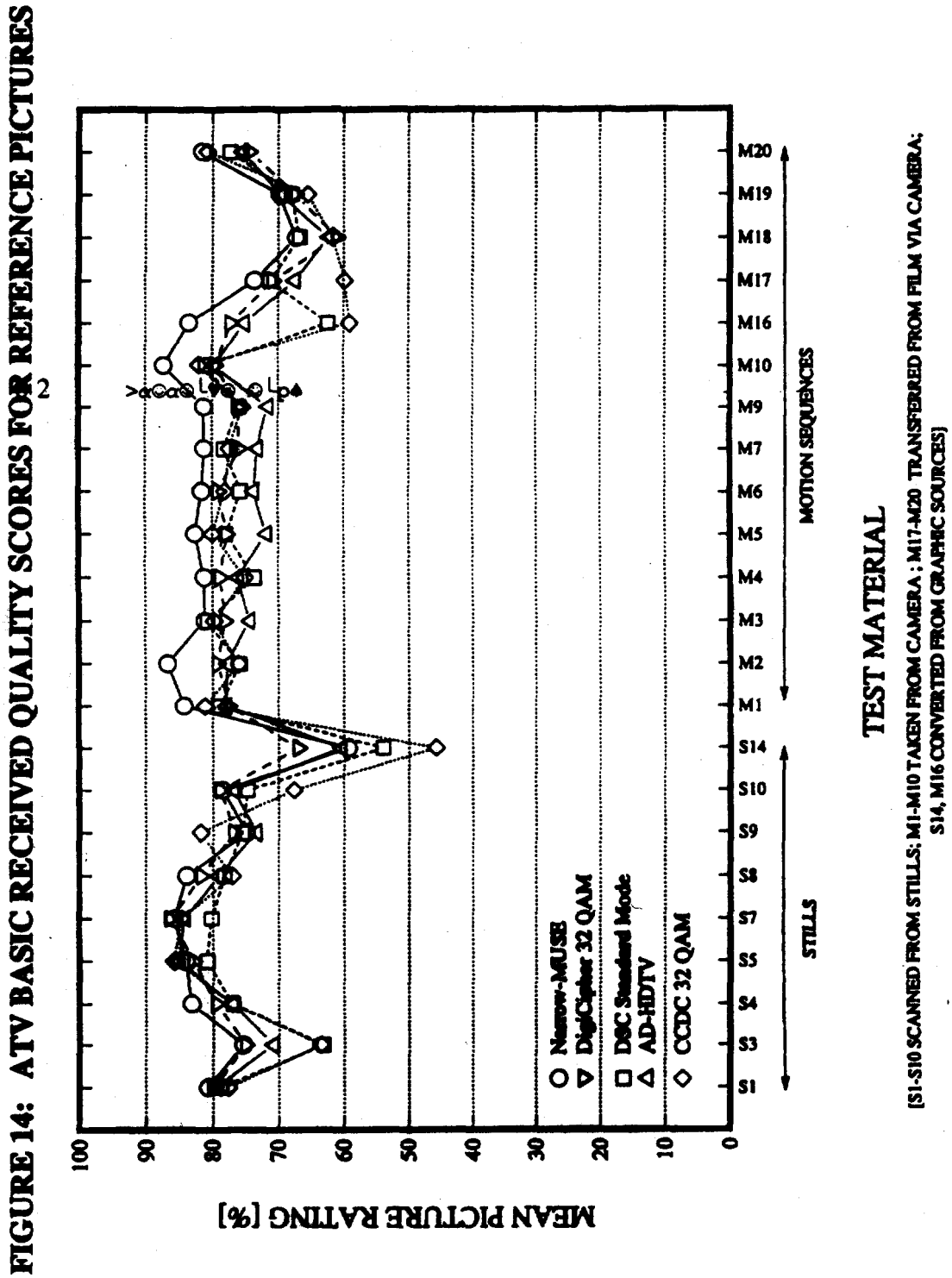



FIGURE 14: ATV BASIC RECEIVED QUALITY SCORES FOR REFERENCE PICTURES

[redacted]

## PURPOSES OF THESE TESTS

[redacted]

Identical scores do not mean that the images and their artifacts were indistinguishable. Identical scores mean that the overall image quality (the net effects of all visible artifacts) was judged the same. Sometimes this involved trade-off among the subjective impressions of different artifacts (e.g., pulsating noise vs. color resolution, pulsating noise vs. more random "white" noise, etc.).

## CONCLUSIONS

In these rankings of unimpaired image quality, two of the systems, DigiCipher and AD-HDTV, were judged superior to the other three systems. It is difficult to find significant differences in the overall image quality of these two systems.

## DETAILED TEST RESULTS

The images and relative scores are presented in the following tables.